Pest Alert

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Forest Service
Northeastern Area
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Elm Yellows

Elm yellows (EY), formerly known as elm phloem necrosis, is a lethal systemic disease of native elms caused by a wall-less bacteria called a phytoplasma. The elm yellows phytoplasma is '*Candidatus* Phytoplasma ulmi.' An unnamed phytoplasma in the clover proliferation group has caused EY in one locality.

The only known hosts of the EY phytoplasma are elms (*Ulmus* spp.) and insect vectors that transmit this pathogen. In the United States the disease is transmitted by the whitebanded elm leafhopper (*Scaphoideus luteolus*) and possibly other insects that feed on phloem sap. There is no known resistance to EY in native elms of North America, but some Eurasian species are tolerant or resistant.

Distribution

Elm yellows poses a threat to native elm trees across the eastern half of the United States. The disease has been reported in Alabama, Arkansas, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Nebraska, New Jersey, New York, North Dakota, Ohio, Oklahoma, Pennsylvania, Tennessee, Virginia, and West Virginia. Local to regional epidemics kill nearly all native elms. The disease has also been found in parts of Central and Southern Europe, where it is considered to be of little importance and is usually not lethal.

Tree Hosts

Tree species affected by EY in North America include American elm (*Ulmus americana*), slippery or red elm (*Ulmus rubra*), winged elm (*Ulmus alata*), September elm (*Ulmus serotina*), cedar elm (*Ulmus crassifolia*), and the hybrid red × Siberian (*U. rubra* × *pumila*). Eurasian elms in EY outbreak areas in the United States have remained unaffected. Grafting tests of American elm cultivars, including Independence, New Harmony, Jefferson, and Valley Forge, which are resistant to the Dutch elm disease pathogen (*Ophiostoma novo-ulmi*), were found to be susceptible to EY.

Tree Symptoms and Identification

The EY phytoplasma inhabits the innermost bark (phloem) sieve elements of elms. Intolerant elms die within a year or two after symptoms appear. Foliar symptoms usually appear from mid-July to mid-September in the Northern United States and include yellowing, drooping, and premature leaf drop (figures 1 and 2). Symptoms may resemble those caused by water stress or nutrient deficiencies and generally affect the entire crown, but initially only a portion of the tree may show symptoms. Tolerant elms (Eurasian species) affected by EY typically grow slowly, become stunted and chlorotic, and may produce small witch's brooms.

Figure 1.—Foliar symptoms of elm yellows in *Ulmus americana*.

Figure 2.—Chlorosis and epinasty (downward bending of leaves) on the branch at right, contrasted with normal foliage on the left.

Rootlet and phloem necrosis typically precede foliar symptoms. The current year's phloem and cambial zone usually darkens from a healthy near-white color to butterscotch, sometimes with darker flecks (figure 3). An odor of wintergreen oil (methyl salicylate) may be noticed when moist phloem is exposed. Placing freshly exposed inner bark into an airtight container may concentrate the wintergreen scent. Visual symptoms and wintergreen odor are diagnostic for EY in American elm species. Slippery elms dying from EY may give off an odor similar to that of maple syrup.

It is not possible to culture this pathogen. Electron microscopy can be used to detect the phytoplasma in sieve cells. Molecular techniques are available for confirming the presence of the phytoplasma.

Figure 3.—Phloem symptoms in *Ulmus americana* from healthy (left) to diseased (middle and right).

Control

No practical means of prevention or therapy are available. Affected elms should be removed immediately to prevent the spread of this disease to nearby elms. When replacing lost elms with new elms, use Eurasian species or cultivars.

Distinction from Other Common Elm Diseases

Trees infected by bacterial leaf scorch (figure 4) or Dutch elm disease (figure 5) often exhibit symptoms similar to those of EY. See the table for distinguishing symptoms of these three elm diseases.

Elm yellows	Bacterial leaf scorch	Dutch elm disease
Systemic; generally affects the entire crown.	Damage is initially observed on single branches and spreads to the entire crown; the oldest leaves are affected first.	Initially affects individual branches or lower crown nearest a root graft.
Leaves turn yellow and may drop early.	Leaves brown along the margin with a yellow halo.	Leaves wilt and turn yellow, then brown.
Symptoms visible from July to September.	Symptoms appear in summer and early fall.	Symptoms are often observed in early summer, but may be exhibited any time of the growing season.
No discoloration in sapwood.	No discoloration in sapwood.	Brown streaking in sapwood.
Tan discoloration of inner bark.	No discoloration of inner bark.	No discoloration of inner bark.
Wintergreen odor in inner bark.	No wintergreen odor.	No wintergreen odor.

Figure 4.—*Ulmus americana* leaf displaying symptoms of bacterial leaf scorch disease. The halo effect is characteristic of this disease.

Figure 5.—Brown streaking in sapwood of an elm infected with Dutch elm disease.

Photographs:

Figure 1: Wayne Sinclair, Cornell University
Figure 2: Wayne Sinclair, Cornell University
Figure 3: Wayne Sinclair, Cornell University
Figure 4: Danielle Martin, USDA Forest Service
Figure 5: Joseph O'Brien, USDA Forest Service

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